

OCCASIONAL PAPERS



Museum of Texas Tech University

NUMBER 191

16 June 1999

ZAPUS HUDSONIUS IN SOUTHERN COLORADO

CHERI A. JONES

Two species of jumping mouse (Zapodidae: *Zapus*) are known from Wyoming, Colorado, and New Mexico. The western jumping mouse (*Z. princeps princeps*) is the more common and widely distributed species in the region. It occurs throughout the western two-thirds of Colorado, mainly in riparian vegetation and mesic meadows from 1830 to 3500 m (Armstrong, 1972; Fitzgerald et al., 1994). Fitzgerald et al. (1994) suggested the possible occurrence of *Z. p. utahensis* in northwestern Colorado. The meadow jumping mouse (*Z. hudsonius*) is represented by three taxa, all with restricted distributions, in Wyoming, Colorado, New Mexico, and Arizona. The range of *Z. hudsonius campestris* includes the Black Hills of northeastern Wyoming (Clark and Stromberg, 1987). Preble's meadow jumping mouse, *Z. h. preblei*, is known only from Colorado's Front Range and from southeastern Wyoming (Clark and Stromberg, 1987; Fitzgerald et al., 1994). A third subspecies, *Z. h. luteus*, occupies isolated patches in New Mexico and in southeastern Arizona (Hafner et al., 1981). Local distributions of the taxa *luteus* and *preblei* are of special interest (e.g., Morrison, 1990, 1992; Meaney et al., 1996, 1997; Ryan, 1996; Hafner, 1997); New Mexico listed

luteus as endangered in 1983 and *preblei* was listed as federally threatened on 12 May 1998. The report by Clarion Associates (1998) includes a bibliography compiled by Chris Pague (cpague@tnc.org), which lists numerous surveys and status reports regarding *Z. h. preblei* in Colorado.

In 1996, I caught 14 jumping mice during a survey of mammals on the Lake Dorothea State Wildlife Area, southeast of Trinidad in Las Animas County, Colorado. The wildlife area is located in Sugarite Canyon, between Barela Mesa and Fishers Peak Mesa. Sugarite Canyon opens southwards, approximately 16 km NE of the city of Raton, New Mexico. Two creeks (Chicorica and Schwacheim) and two lakes (Dorothea and Maloya) occupy the canyon north of the Colorado border. Vegetation on the floor of the canyon includes meadows of grasses and forbs, in which meadow voles (*Microtus pennsylvanicus*) were the most frequently-captured rodent. Ruderal vegetation lines roads and parking areas; scrub oak (*Quercus gambelii*), ponderosa pines (*Pinus ponderosa*), and other conifers occupy the walls of the canyon. Jones (1996; in press) provided more detailed descriptions of the vicinity.

MATERIALS AND METHODS

In June and July 1996, I captured three jumping mice in Sherman live traps as part of a general survey of mammals (Jones, 1996). Consequently, in August 1996, C. Jones, D. Meshko, and I set snap traps to sample small mammals along Chicorica and Schwacheim creeks. I determined localities using the Global Positioning System and the U.S.G.S. Barela Quad topographic map. Skins and skulls were deposited in the Denver Museum of Natural History and frozen tissues were deposited at Texas Tech University. I also collected hair and ear-punch samples for use by the Colorado Division of Wildlife.

I recorded external measurements from skin tags and measured ten cranial characteristics, following Krutzsch (1954) and Hafner et al. (1981): greatest condylobasal length, greatest zygomatic breadth, least interorbital breadth, length of maxillary toothrow, palatal length, palatal breadth at P4, length of incisive foramina,

breadth of incisive foramina, interbullar width (at basioccipital-basisphenoid suture), and greatest mastoid breadth. Specimens were classified as adult or subadult based on presence or absence of wear on M3 (Krutzsch, 1954; Hafner et al., 1981). Sexes were combined, because neither Krutzsch (1954) nor Hafner et al. (1981) found evidence of sexual dimorphism. Measurements of the Lake Dorothea specimens were compared with those of samples of *Z. h. preblei* from Colorado, *Z. h. luteus* from New Mexico, and *Z. p. princeps* from both Colorado and New Mexico. Specific localities and catalogue numbers of material from the Denver Museum of Natural History (DMNH), the Museum of Southwestern Biology (MSB), the University of Colorado Museum (UCM), and of tissues from Lake Dorothea specimens deposited in the frozen tissue collection of Texas Tech University (TK), are listed under Specimens Examined. Nomenclature follows that of Saldaña-DeLeon and Jones (1998).

RESULTS AND DISCUSSION

The first jumping mice caught near Lake Dorothea were two nonscrotal males captured 11 June 1996 in Sherman live traps along the south bank of Schwacheim Creek, one on either side of the footbridge between lakes Dorothea and Maloya. Both mice were captured in riparian vegetation consisting of grasses, forbs, and coyote willow (*Salix exigua*); one was prepared as a voucher (DMNH 8630). On 16 July a gravid female (DMNH 8631) carrying six embryos (measuring 6x4 mm) was captured in ruderal vegetation, including wild rose (*Rosa* sp.), legumes, and grasses, along the road through Sugarite Canyon. *Microtus pennsylvanicus*, *Reithrodontomys megalotis*, and *Thomomys talpoides* also were captured in this trapline. Eleven additional individuals (DMNH 8632-8642), including two lactating females, were caught in August 1996 in snap traps deployed at water's edge along Chicorica Creek and along the West Fork of Schwacheim Creek above Lake Dorothea. Vegetation at Chicorica Creek consisted primarily of willow; other species of mammals caught there were *Sorex palustris* and *M. pennsylvanicus*. Along the West Fork of Schwacheim Creek, willows were less abundant and the heavy groundcover consisted primarily of grasses and forbs; jumping mice were captured in the same

trapline as *S. monticolus*, *S. palustris*, *M. longicaudus*, and *Peromyscus maniculatus*. Thus, jumping mice were known from four different localities (all below an elevation of 7800') on the Lake Dorothea State Wildlife Area in 1996. An additional male (DMNH 9065) was captured near Chicorica Creek 24 August 1997 on the Lake Dorothea State Wildlife Area by staff of the Colorado Natural Heritage Program; this animal was collected 2-3 m from the water's edge underneath willow (M. B. Wunder, pers. comm., 1998). Except for this male and the female (DMNH 8631) collected on the roadside, all specimens from Lake Dorothea were captured no more than 1 m from the water, although others (Whitaker, 1972; Choate et al., 1991; Tester et al., 1993; Zwank et al. 1997; also see discussion by Morrison 1990:141) have reported captures of *Z. hudsonius* at more variable distances from water. Captures at greater distances from water might represent dispersal and/or movement to nests and hibernacula (e.g., Zwank et al., 1997).

Only measurements of adults were used in analyses. Average (and extreme) measurements of the nine adults from Lake Dorothea and of comparative material are shown on Tables 1 and 2. I did not in-

clude length of ear, which was not recorded by most early collectors of *Zapus*. Initial assignment of the Lake Dorothea material to the species *Z. hudsonius* was indicated by the presence of the anteromedian fold on the anterior edge of the m1 (Klingener, 1963; Hafner, 1993) and by characters in the key developed by Armstrong (1972:248) to separate Colorado *Zapus*; i.e., *Z. h. preblei* is distinguished from *Z. p. princeps* by a zygomatic breadth usually less than 11.5 mm and incisive foramina usually 4.5 or shorter. The Lake Dorothea specimens also lack the whitish ear fringe of the *Z. princeps* to which they were compared.

Hafner et al. (1981:509) described *Z. h. luteus* as "ochraceous-buff in color, with a but weakly defined middorsal band; ear either lacking pale fringe or possessing narrow ochraceous fringe; never with a white ear fringe." Only one specimen from Lake Dorothea (DMNH 8631) has a dark, well-defined dorsal stripe and all have an ochraceous-buff color similar to the New Mexican specimens examined. This ochre is brighter than the coloration of the 13 skins of *Z. h. preblei* to which they were compared, resembling the color of the few skins of *Z. h. americanus* and *Z. h. intermedius* housed in the DMNH collection. Generally, skulls of *Z. h. luteus* from New Mexico and from Lake Dorothea are broader and longer than those of *Z. h. preblei* (Table 2). Zygomatic breadth was greater in the specimens of *Z. h. luteus* from New Mexico than those from Colorado.

Ear and hair samples from 10 Lake Dorothea specimens (DMNH 8632-8637, 8639-8642) were included in mitochondrial-DNA analyses conducted by Biosphere Genetics Inc; non-coding region sequence data also suggested that jumping mice from Lake Dorothea belong to the subspecies *Z. h. luteus* (Riggs et al., 1997; pers. comm., 1998).

The population of *Zapus* on the Lake Dorothea State Wildlife Area represents the first reported in extreme southern Colorado. Neither species of *Zapus* was previously known near Sugarite Canyon (Armstrong, 1972). Six specimens collected by C. A. Meaney in San Isabel National Forest (in July 1991) extended the known range of *Z. princeps* into Las Animas County, approximately 64 km (40 air miles) northwest of Lake Dorothea. The southernmost record of *Z. h. preblei* is in El Paso County, approximately 224 km (140 miles) north of Las Animas County (C. A. Meaney and C. Pague, in litt, 1999). The closest historic record of *Z. h. luteus* in northern New Mexico is North Williams Lake in the Sangre de Cristo Mountains (Morrison, 1992), about 144 km (90 air miles) southwest of Lake Dorothea. The possible occurrence of isolated populations of *Zapus* along the Colorado-New Mexico border needs to be investigated further to elucidate the historical biogeography and present ecological requirements of members of this genus.

Table 1. Selected external measurements (means and extremes) of four samples of *Zapus*. Sample sizes were N=9 (*Z. h. luteus* from New Mexico), N=9 (*Zapus* from Lake Dorothea), N=12 (*Z. h. preblei*), and N=30 (*Z. p. princeps*).

	Total length	Length of Tail	Hindfoot
<i>Z. h. luteus</i>	213.4(205-221)	126.2(118-130)	29.6(28-31)
Lake Dorothea	211.8(204-216)	123.6(119-131)	29.4(29-31)
<i>Z. h. preblei</i>	208.5(195-231)	124.6(116-137)	29.7(27-32)
<i>Z. p. princeps</i>	231.0(200-247)	139.0(125-156)	31.6(29.5-34)

Table 2. Means and extremes for condylobasal length, zygomatic breadth, interorbital breadth, maxillary tooththrow length, palatal length, palatal breadth, incisive foramina length, incisive foramina breadth, infraorbital width, and mastoid breadth of four samples of *Zapus*. Sample sizes were N=10 (*Z. h. luteus* from New Mexico), N=9 (*Zapus* from Lake Dorothea), N=13 (*Z. h. preblei*), and N=30 (*Z. p. princeps*); smaller samples due to missing measurements are indicated.

	CB length	Zygomatic	Interorbital	Max tooth	Pal length	Pal breadth	IF length	IF width	IB width	Mastoid
<i>Z. h. luteus</i>	21.2 (20.7-21.6) N=9	11.7 (11.2-12.3) N=8	4.5 (4.2-4.6)	3.9 (3.7-4.0)	11.1 (10.7-11.5)	3.4 (3.0-3.6)	4.3 (4.1-4.5) N=9	2.4 (2.2-2.5)	1.9 (1.6-2.1) N=9	10.7 (10.0-11.0) N=9
Lake Dorothea	20.8 (20.2-22.0)	11.4 (11.3-12.0) N=8	4.5 (4.3-4.7)	3.8 (3.6-4.0)	11.0 (10.7-11.5)	3.5 (3.3-3.6) N=8	4.0 (3.8-4.4)	2.1 (2.1-2.3)	1.97 (1.8-2.2)	10.6 (10.3-11.0)
<i>Z. h. preblei</i>	20.8 (19.9-21.8)	10.9 (10.7-11.8)	4.2 (4.0-4.5) N=12	3.8 (3.6-4.1)	10.5 (9.7-10.8)	3.3 (3.0-3.4)	4.3 (4.1-4.6)	2.1 (1.9-2.2)	1.9 (1.6-2.2)	10.6 (9.9-11.0)
<i>Z. princeps princeps</i>	22.1 (19.5-23.5) N=26	12.5 (11.7-13.2) N=26	4.4 (4.1-4.7) N=28	4.2 (3.8-4.4)	11.5 (10.1-12.3) N=26	3.7 (3.3-4.0)	4.6 (4.0-5.2)	2.3 (2.0-2.5)	2.4 (2.1-2.9) N=23	11.1 (10.6-11.4) N=23

ACKNOWLEDGMENTS

I am grateful to W. L. Gannon and T. R. Yates of the Museum of Southwestern Biology and to R. Humphrey of the University of Colorado Museum for allowing me to examine specimens in those collections. I thank D. M. Armstrong and D. J. Hafner for reviews of the manuscript; C. A. Meaney, L. A. Riggs, and T. R. Ryon for useful discussions regarding *Z. hudsonius*; C. Jones and D. Meshko for wading creeks with me in pursuit of small mammals; and C. N. Ramos for preparation of many of the specimens deposited in the collection of the Denver Museum of Natural History. Research at Lake Dorothea was funded by the Colorado Division of Wildlife, the Colorado Natural Areas Program, and the Denver Museum of Natural History.

SPECIMENS EXAMINED:

Zapus hudsonius americanus (1): New York: Otsego Co: Cherry Valley, 1 (DMNH 7476).

Zapus h. intermedius (4): North Dakota: Mercer Co: 3 km N Hazen, 3 (DMNH 7761, 7762, 7764); T145N, R87S, Sec 13, 1 (DMNH 7763).

Zapus h. luteus (31): Colorado: Las Animas Co: Lake Dorothea State Wildlife Area: Schwacheim Creek (36°59'48"N, 104°22'03"W; UTM 13 0556404E, 4094451N), 1 (DMNH 8630/TK 51253); 37°00'04"N, 104°21'30"W; UTM 13 0557093E, 4095188N, 1 (DMNH 8631/TK 51263); Chicorica Creek (37°00'02"N, 104°21'39"W; UTM 13 0556871E, 4095125N), 6 (DMNH 8632-8637/TK 51294, 51295, 51305-51308); NW of Lake Dorothea, West Fork Schwacheim Creek (37°00'25"N, 104°22'32"W; UTM 13 0555556E, 4095825N), 5 (DMNH 8638-8642/TK 51352-51356); Lake Dorothea State Wildlife Area, Chicorica Creek about 0.2 mi (0.3 km) upstream from confluence with Lake Maloya (UTM 13 0556480E, 4094600N), 1 (DMNH 9065). New Mexico: Bernalillo Co: Isleta, T8N, R2E, Sec 12, 1 (MSB 58368); Otero Co: 8 mi E Cloudcroft, 1 (MSB 37155), 3.2 mi E (by road) Cloudcroft, 3 (MSB 41060, 41062, 41064), Silver Springs Canyon, T15S, R13E, Sec 29, 1 (MSB 61701); Sandoval Co: T19N, R2E, SW Sec 10, Fenton Lake, marsh E of lake, E of Rte 126, 1 (MSB 56982);

Rio Cebolla, T19N, R1E, no section, 1 mi upstream from intersection with Rio Las Vacas, 1 (MSB 62097); T19N, R2E, NE Sec 30, Rio Cebolla at intersect. of Rte 376 & Lake Fork Creek, 1 (MSB 56985); Socorro Co: 8 mi S San Antonio, Bosque del Apache National Wildlife Refuge, 6 (MSB 41223, 41225, 41226, 41228, 41229, 41234), 11 mi S San Antonio, Bosque del Apache Game Refuge, 2 (MSB 36119, 36143).

Zapus h. preblei (21): Colorado: Adams Co: Croak's Lake, 1 (DMNH 2822); Boulder Co: South Boulder Creek, irrigation ditch, 1 (DMNH 9314), ¼ mi S St. Vrain Road on U.S. hwy 36 on unnamed drainage, UTM 13 0477420E, 4446330N, elevation 1689 m, 2 (DMNH 9204, 9205), south of Boulder, 1 (UCM 1225), 3 mi E Boulder, 1 (UCM 551), 5 mi E Boulder, 1 (UCM 503), 8.5 mi N, 3 ¼ mi E Boulder, 1 (UCM 5210), 0.5 mi SSE Eldorado Springs, T1S R70W NE ¼ NW ¼ Sec 31, 6000', 1 (UCM 17001), Niwot, 1 (DMNH 2394); 3 mi NW Niwot, 1 (DMNH 2971); Douglas Co: West Plum Creek, 8 mi N county line, T9S R68W, SW ¼ SW ¼ Sec 24, 2 (UCM 17003, 17004); El Paso Co: U.S. Air Force Academy, 1 (DMNH 9315), U.S. Air Force Academy, Monument Creek, 0.25 mi S Sewage Treatment Plant, T12S R67W SW ¼ NW ¼ NW ¼ Sec 30, 6440', 1 (UCM 17002),

Monument, Dirty Woman Creek, T11S R67W NE ¼ SW ¼ Sec 14, UTM 13 0512100E, 4326700N, 1 (DMNH 9206), near Monument on Dirty Woman Creek, T11S R67W, NE ¼ SW ¼ Sec 14, UTM 13 0512100E, 4326700N, 1 (DMNH 9313); Gilpin Co: along Ralston Creek, T2S R70W NE ¼ SW ¼ Sec 31, 6400', 1 (DMNH 9312); Jefferson Co: 1¼ mi W Semper, 2 (DMNH 6633, 6634), Rocky Flats, Walnut Creek Drainage, 5809', 1 (DMNH 9203).

Zapus princeps princeps (38): Colorado: Archuleta Co: Devil's Creek, near Dyke, 2 (DMNH 5575, 5576); Upper Navajo River, 5 (DMNH 1227, 1229-1231, 1233); headwaters of Navajo River, 9 (DMNH 1483-1489, 1498, 1499); Boulder Co: 7,000 ft, 2 (DMNH 3258, 3354); 3 mi E Pine Cliff, 3 (DMNH 3378-3380); Clear Creek Co: Camp Lemon, 2 (DMNH 4395, 4396); Gunnison Co: Taylor Park, 1 (DMNH 3903); Jackson Co: 4 mi NW Northgate, 2 (DMNH 1052, 1053); Las Animas Co: San Isabel National Forest, Purgatoire Campground, 2625 m, 6 (DMNH 7914-7919); Routt Co: Dome Peak, Middle Stillwater Creek, 1 (DMNH 4938); Stillwater Reservoir, 10,300 ft, 3 (DMNH 4970-4972). New Mexico: Taos Co: 4 mi N, 11 mi E Arroyo Hondo, 2 (MSB 41346, 41347).

LITERATURE CITED

- Armstrong, D. M. 1972. Distribution of mammals in Colorado. Monograph of the Museum of Natural History, The University of Kansas, No. 3, x + 415 pp.
- Choate, J. R., D. W. Moore, and J. K. Frey. 1991. Dispersal of the meadow jumping mouse in northern Kansas. *Prairie Naturalist*, 23:127-130.
- Clarion Associates, LLC. 1998. Preble's meadow jumping mouse collaborative planning process. Preliminary progress report prepared for the Colorado Department of Natural Resources.
- Clark, T. W. and M. R. Stromberg. 1987. Mammals in Wyoming. Publication Education Series, University of Kansas Museum of Natural History, 10:xii + 1-314.
- Fitzgerald, J. P., C. A. Meaney, and D. M. Armstrong. 1994 [1995]. Mammals of Colorado. Denver Museum of Natural History and the University Press of Colorado, Niwot, 467 pp.
- Hafner, D. J. 1993. Reinterpretation of the Wisconsinian mammalian fauna and paleoenvironment of the Edwards Plateau, Texas. *Journal of Mammalogy*, 74:162-167.
- _____. 1997. Evaluation of the taxonomic, genetic, and conservation status of Preble's jumping mouse, *Zapus hudsonius preblei*, and associated subspecies. Final report, submitted to the Colorado Division of Wildlife, 8 pp.
- Hafner, D. J., K. E. Petersen, and T. L. Yates. 1981. Evolutionary relationships of jumping mice (genus *Zapus*) of the southwestern United States. *Journal of Mammalogy*, 62:501-512.
- Jones, C. A. 1996. Mammals of the James John and Lake Dorothea state wildlife areas. Final report, submitted to the Colorado Division of Wildlife and to the Colorado Natural Areas Program, 27 pp.
- _____. In press. An annotated list of mammals of the James M. John State Wildlife Area. Proceedings of the Colorado Natural Areas Symposium.
- Klingener, D. 1963. Dental evolution of *Zapus*. *Journal of Mammalogy*, 44:248-260.
- Krutzsch, P. H. 1954. North American jumping mice (genus *Zapus*). University of Kansas Publications, Museum of Natural History, 7:349-472.

- Meaney, C. A., N. W. Clippinger, A. Deans, and M. O'Shea-Stone. 1996. Second year survey for Preble's meadow jumping mouse (*Zapus hudsonius preblei*) in Colorado. Final report, submitted to the Colorado Division of Wildlife, 47 pp.
- Meaney, C. A., A. Deans, N. W. Clippinger, M. Rider, N. Daly, and M. O'Shea-Stone. 1997. Third year survey for Preble's meadow jumping mouse (*Zapus hudsonius preblei*) in Colorado. Final report, submitted to the Colorado Division of Wildlife, 56 pp.
- Morrison, J. L. 1990. The meadow jumping mouse in New Mexico: habitat preferences and management recommendations. Pp. 136-143, in *Proceedings of the symposium on managing wildlife in the Southwest* (P. R. Krausman and N. S. Smith, eds.). Arizona Chapter, The Wildlife Society, Phoenix.
- _____. 1992. Persistence of the meadow jumping mouse, *Zapus hudsonius luteus*, in New Mexico. *Southwestern Naturalist*, 37:308-311.
- Riggs, L. A., J. M. Dempcy, and C. Orrego. 1997. Evaluating distinctness and evolutionary significance of Preble's meadow jumping mouse: phylogeography of mitochondrial DNA non-coding region variation. Final report, submitted to the Colorado Division of Wildlife, 13 pp.
- Ryon, T. R. 1996. Evaluations of the historical capture sites of the Preble's meadow jumping mouse in Colorado. MSES Project Report, University of Colorado-Denver.
- Saldaña-DeLeon, J. L., and C. A. Jones. 1998. Annotated checklist of the recent mammals of Colorado. *Occas. Papers, Mus., Texas Tech Univ.*, 179:1-14.
- Tester, J. R., S. Malchow, C. McLain, and J. B. Lehrer. 1993. Movements and habitat use by meadow jumping mice in northwestern Minnesota. *Prairie Naturalist*, 25:33-37.
- Whitaker, J. O. 1972. *Zapus hudsonius*. *Mammalian Species* 11:1-7.
- Zwank, P. J., S. R. Najera, and M. Cardenas. 1997. Life history and habitat affinities of meadow jumping mice (*Zapus hudsonius*) in the middle Rio Grande Valley of New Mexico. *Southwestern Naturalist*, 42:318-322.

Author's address:

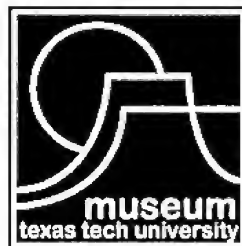
CHERI A. JONES

*Denver Museum of Natural History
2001 Colorado Blvd.
Denver CO 80205-5798
email: cjones@dmnh.org*

PUBLICATIONS OF THE MUSEUM OF TEXAS TECH UNIVERSITY

It was through the efforts of Horn Professor J Knox Jones, as director of Academic Publications, that Texas Tech University initiated several publications series including the Occasional Papers of the Museum. This and future editions in the series are a memorial to his dedication to excellence in academic publications. Professor Jones enjoyed editing scientific publications and served the scientific community as an editor for the Journal of Mammalogy, Evolution, The Texas Journal of Science, Occasional Papers of the Museum, and Special Publications of the Museum. It is with special fondness that we remember Dr. J Knox Jones.

Institutional subscriptions are available through the Museum of Texas Tech University, attn: NSRL Publications Secretary, Box 43191, Lubbock, TX 79409-3191. Individuals may also purchase separate numbers of the Occasional Papers directly from the Museum of Texas Tech University.



ISSN 0149-175X

Museum of Texas Tech University, Lubbock, TX 79409-3191